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EV 404053336 US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of: Francis M. Creighton, IV et al.

Serial No.: 10/082,715

Filed: February 25, 2002

For: Magnets with Varying Magnetization Directions and Method of Making Such Magnets

Examiner: L. Donovan

Group Art Unit: 2832

Commissioner for Patents
P.O. Box 1450
Alexandria 22313-1450

APPLICANT'S BRIEF ON APPEAL

Pursuant to 37 C.F.R. § 1.192, Applicant submits its Brief on Appeal, as follows:

Real Party in Interest (37 C.F.R. § 1.192 (c)(1))

The real party in interest in this appeal is Stereotaxis, Inc., a Delaware corporation, having a place of business at 4041 Forest Park Avenue, St. Louis, MO 63136, by virtue of an assignment recorded October 13, 2000, at Reel 011221, Frame 0252.

Related Appeals and Interferences (37 C.F.R. §1.192(c)(2))

There are no other appeals or interferences known to Applicant, or to Applicant's legal representatives or assignees, which will directly affect, or would be directly affected by, or have a bearing on, the Board's decision in this appeal.

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Status of the Claims (37 C.F.R. §1.192(c)(3))

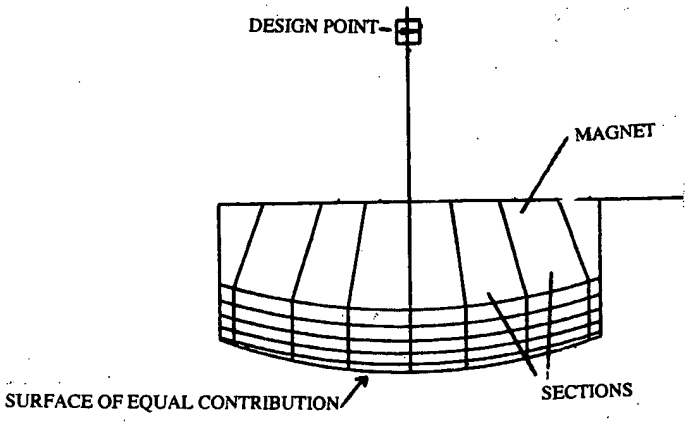
Claims 1, 2, 5, 6, and 31-51 were finally rejected in the Office Action of August 20, 2003, and are the subject of this appeal.

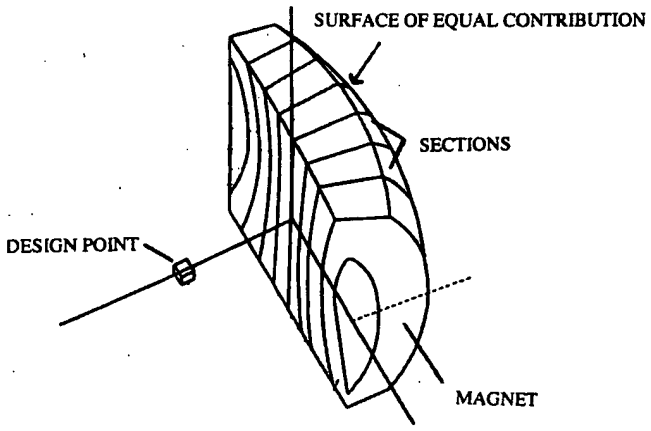
Status of Amendments (37 C.F.R. §1.192(c)(4))

No amendments were filed after the final rejection of August 20, 2003.

Summary of Invention (37 C.F.R. §1.192(c)(5))

This invention relates to a compound magnet which in a preferred embodiment is comprised of a plurality of sections. As shown in Figures (based on Fig. 26A and 26B) of the application) the magnet comprises a plurality of sections. Each section is magnetized in a direction that optimizes a particular field property of the magnet at a selected design point. Moreover, the magnet is preferably shaped at least in part from lines of equal contribution, so that the magnet has the most efficient shape, and thus least weight, for the desired field property.





In one preferred embodiment the magnet is shaped to, and the various sections are magnetized in directions to optimize, the magnetic field strength in a particular direction at the selected design point. This specific magnet is useful in a magnetic surgery system in which the one or more such magnets are manipulated outside the body to create a strong magnetic field in a selected direction inside the body. The shaping of the magnet, and the optimization of the magnetic field direction allows the magnet to be smaller in size and weight than a conventional magnetic producing the same magnetic field at the same selected point. Thus, in the case of magnet surgery, smaller magnets can be used, which means that they take up less room around the patient, can be positioned closer to the patient (which allows further reductions in the size of the magnet, since magnet field strength diminishes with the fourth power of the distance), and which can be manipulated by smaller, less expensive equipment.

While a principal use of magnets of the invention is magnetic surgery, the magnets have application in an situation where a particular magnetic property at a specified point in space relative to the magnet is needed, for example in magnetic levitation trains.

Issues (37 C.F.R. §1.192(c)(6))

Would the Invention Set Forth in Claims 1-2, 5-6, and 31-51 have Been Obvious Under 35 U.S.C. § 103 from Leupold?

Would the Invention Set Forth in Claims 9-10 have Been Obvious Under 35 U.S.C. § 103 from Leupold in view of Golden et al.?

Grouping of Claims (37 C.F.R. §1.192(c)(7))

Claims 1, 2, 5, 6, 9, 10, 31, and 33, 46-48 stand together. Claims 34-40, 42, and 49-51 are separately patentable in view of their requirement that the magnet is bounded by a surface of equal contribution. Claims 36 and 44 are separately patentable in view of their requirement that the magnetization direction of the sections be the direction that, at the center of mass, provides the maximum contribution to the desired property optimizing

the field. Claims 37 and 45 are separately patentable in view of their requirement that the magnetization direction of the sections be the direction that, at the effective magnet center, provides the maximum contribution to the desired property optimizing the field. Claims 40 and 48 are separately patent able in view of their requirement that the magnetization direction in each section is not constant.

Argument (37 C.F.R. §1.192(c)(8))

The Invention Set Forth in Claims 1-2, 5-6, and 31-51
Would Not have Been Obvious Under 35 U.S.C. § 103 from Leupold

Claims 1 and 2

Claim 1 (and claim 2 which depends from claim 1) requires "A permanent magnet in which the magnetization direction varies in three dimensions with location to optimize a desired magnetic field property in a selected direction at a selected point." In contrast, Leupold teaches a magnet in which the magnetization direction varies to achieve a uniform field direction in a volume inside the magnet. Leupold does not teach optimizing a desired magnetic field property at a point; Leupold teaches achieving a uniform magnetic field direction throughout a volume. For example, if any point in the Leupold volume were selected as the "selected point" as used in claim 1, it is apparent that the sections in the Leupold magnet are not magnetized in order to optimize a magnetic field property at this selected point, but instead are magnetized in directions that cause a uniform field in the volume around the selected point.

Claim 2 further requires specifies the magnetic field property that is optimized. Leupold teaches providing a uniform field in a volume, and does not teach optimizing these, or any other properties, at a selected point.

Claims 5 and 6

Claim 5 (and claim 6 which depends from claim 5), like claim 1 discussed above, requires a permanent magnet in which the magnetization direction varies in "to optimize a desired magnetic field property in a selected direction at a selected point". (Claim 5 differs from claim 1 in that it specifies that the magnetization direction of the various segments varies on two dimensions, rather than three dimensions). Leupold does not teach optimizing a desired magnetic field property at a point; Leupold teaches achieving

a uniform magnetic field direction in a volume. In order to achieve the uniformity of field direction throughout the volume, the magnetization directions of the Leupold segments would have to be different than if they were selected to optimize a magnetic field property at a single point, and thus the Leupold magnet is different from the claimed magnet, and there is nothing in Leupold to teach designing a magnet as applicant has claimed.

Claim 6 further requires specifies the magnetic field property that is optimized. Leupold teaches providing a uniform field in a volume, and does not teach optimizing these, or any other properties, at a selected point.

Claims 31

Claim 31 requires "a permanent magnet in which the magnetization direction varies with location to optimize the magnetic field at a selected point in a selected direction, the magnetization direction varying in three dimensions so that the magnetization at each location in the magnet is in the direction that substantially optimizes the desired magnetic field property at a selected point in the selected direction." Leupold does not disclose a magnet in which the magnetization varies so that the magnetization at each location in the magnet is in the direction that substantially optimizes the desired magnetic field property at a selected point and in a selected direction. While Leupold does show a magnet in which the magnetization varies so that the field direction throughout a volume is in the same direction, Leupold does not show optimizing a property at a particular point independent of how it affects the magnetic field property at other points in the volume. Leupold necessarily compromises the property at a given point in order to achieve uniformity over the volume. There is no reason for a person of ordinary skill in the art to depart from Leupold's focus on a volume to focus on a particular design point. Furthermore there is no teaching in Leupold of optimizing a property at a point in a particular direction.

Claim 32

Claim 32, like claim 31 discussed above, requires "a permanent magnet in which the magnetization direction varies with location to optimize the magnetic field at a selected point in a selected direction, the magnetization direction varying in two dimensions so that the magnetization at each location in the magnet is in the direction

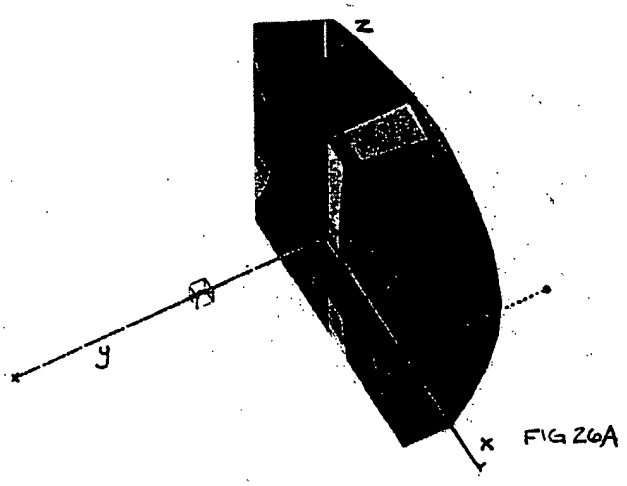
that substantially optimizes the desired magnetic field property at a selected point in the selected direction." (Claim 32 differs from claim 31 in that it specifies that the magnetization direction of the various segments varies on two dimensions, rather than three dimensions). Thus, claim 32 is not obvious from Leupold for the same reasons discussed above with respect to claim 31.

Claims 33-40

Claim 33 (and claims 34-40 which depend from Claim 33) requires "A permanent magnet in which the magnetization direction varies with location to optimize the magnetic field at a selected point in a selected direction, the magnet comprising a plurality of permanent magnet segments, the magnetization direction of each permanent magnet segment varying in three dimensions so that the magnetization direction of each permanent magnet segment is in the direction that substantially optimizes the magnetic field at the selected point in the selected direction." As discussed above with respect to claim 31, Leupold does not disclose a magnet in which the magnetization varies so that the magnetization at each location in the magnet is in the direction that substantially optimizes the desired magnetic field property at selected point and in a selected direction either generally, as set forth in claim 31 or in discrete segments, as set forth in claim 33

Claim 34 (and claims 35-40 which depend from claim 34) further requires that "at least a portion of the surface of the magnet conforms to a surface of constant contribution to the magnetic field at the selected point." There is no teaching or suggestion in Leupold of a magnet bounded by a surface of equal contribution to the field at a particular point. Constraining the shape of the magnet in this way means that a magnet of a given field strength can be made smaller and lighter. This is made possible because the claims optimize a field property at a particular point – something that Leupold does not do.

A comparison of Fig. 26A with Fig. 27A illustrates that a magnet with a face conforming to a surface of equal contribution to the desired field can be smaller and therefore lighter, than a magnet comprises of regularly shaped (e.g. rectangular segments). Because there is no teaching of optimizing a magnet for a particular point, there was no reason to (or ability to) identify and use the surface of equal contribution.



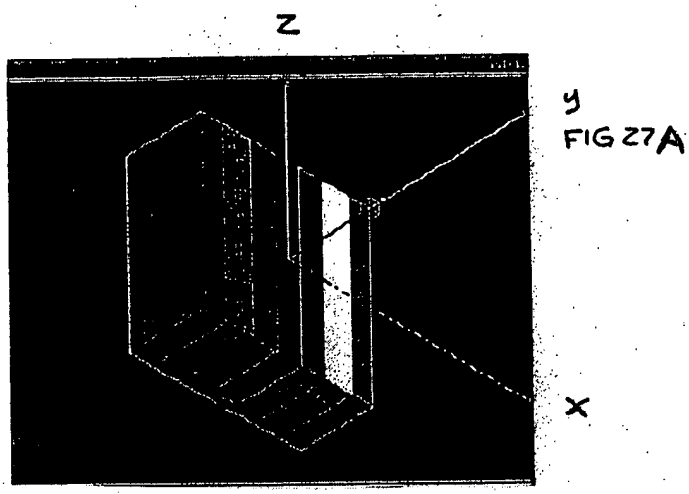


Fig. 26A

Fig. 27A

Claim 36 further requires that the direction of magnetization throughout each permanent magnet segment is the direction which, at the center of mass of the segment, provides the maximum contribution to optimizing the field. Leupold does not teach the magnetization direction specified in claim 36. Instead, Leupold discloses that the magnetization direction (the orientation of the remanence) of each section is a function of the average polar angle of the section. See column 4, lines 31-35. The orientation of the magnetization direction in Leupold is purely a function of the location of the segment, and not the magnetization direction that, at the center of mass of the section, optimizes the desired field property at a selected point in a selected direction as required in claim 36.

Claim 37 further requires that the direction of magnetization throughout each permanent magnet segment is the direction which, at the effective magnet center, provides the maximum contribution to optimizing the field. Leupold does not teach the

magnetization direction specified in claim 37. As pointed out above with respect to claim 36, Leupold discloses that the magnetization direction (the orientation of the remanence) of each section is a function of the average polar angle of the section. See column 4, lines 31-35. The orientation of the magnetization direction in Leupold is purely a function of the location of the segment, and is not the magnetization direction that, at the effective magnet center, optimizes the desired field property, as required by claim 37.

Claim 38 further requires that the size and position of the permanent magnet segments is selected so that the difference in the direction of magnetization direction between adjacent magnet segments is less than about 45°. Claim 39 further requires that "the size and position of the permanent magnet segments is selected so that the difference in the direction of magnetization direction between adjacent magnet segments is less than about 30°." These requirements are not shown or suggested in Leupold, which does not reference any limitation on the magnetization direction between adjacent segments.

Claim 40 requires that the magnetization direction through throughout each permanent magnet segment is not constant.

Claim 41-48

Claim 41 (and claims 42-48 which depend from claim 41)requires "a permanent magnet in which the magnetization direction varies with location to optimize the magnetic field at a selected point in a selected direction, the magnet comprising: a plurality of permanent magnet segments, the magnetization direction of each permanent magnet segment varying in two dimensions so that the magnetization direction of each permanent magnet segment is in the direction that substantially optimizes the magnetic field at the selected point in the selected direction. (Claim 41 is similar to claim 33, except that claim 41 specifies the direction of magnetization varies in two dimensions rather than three dimensions). As discussed above with respect to claim 33, Leupold does not disclose a magnet in which the magnetization varies so that the magnetization at each location in the magnet is in the direction that substantially optimizes the desired magnetic field property at selected point and in a selected direction.

Claim 42 further requires that "at least a portion of the surface of the magnet conforms to a surface of constant contribution to the desired magnetic field at the selected point." As discussed above with respect to claims 34-40, there is no teaching or

suggestion in Leupold of a magnet bounded by a surface of equal contribution to the field at a particular point. The Leupold magnets have simple geometric shapes, unconstrained by surfaces of constant or equal contribution. Constraining the magnet as claimed means that the magnet of a given field strength can be made smaller and lighter. This is made possible because the claimed magnet optimizes a field property at a particular point – something that Leupold does not do.

Claim 44 requires that "the direction of magnetization throughout each permanent magnet segment is the direction which, at the center of mass of the segment, provides the maximum contribution to optimizing the field." As discussed above with respect to claim 36, Leupold does not teach the magnetization direction specified in claim 44. Instead, Leupold discloses that the magnetization direction (the orientation of the remanence) of each section is a function of the average polar angle of the section. See column 4, lines 31-35. The orientation of the magnetization direction in Leupold is purely a function of the location of the segment, and this is not the magnetization field direction that, at the center of mass of the section, optimizes the desired field property at a selected point in a selected direction, as required by claim 44.

Claim 45 requires that the direction of magnetization throughout each permanent magnet segment is the direction which, at the effective magnet center, provides the maximum contribution to optimizing the field. Leupold does not teach the magnetization direction specified in claim 45. As pointed out above with respect to claim 37, Leupold discloses that the magnetization direction (the orientation of the remanence) of each section is a function of the average polar angle of the section. See column 4, lines 31-35. The orientation of the magnetization direction in Leupold is purely a function of the location of the segment, and is not the magnetization direction that, at the effective magnet center, optimizes the desired field property, as required by claim 45.

Claim 46 requires that the size and position of the permanent magnet segments is selected so that the difference in the direction of magnetization direction between adjacent magnet segments is less than about 45°. Claim 47 requires that the size and position of the permanent magnet segments is selected so that the difference in the direction of magnetization direction between adjacent magnet segments is less than about

30°. As discussed above with respect to claims 38 and 39, these requirements are not taught in Leupold.

Claim 48, like claim 40 above, requires that the magnetization direction throughout each permanent magnet segment is not constant.

Claims 49-51

Claim 49 (and claims 50 and 51 depending therefrom) requires a permanent magnet in which the magnetization direction varies to control the magnetic field produced by the magnet at a selected point, the magnet having a front face, and a back face substantially conforming to a surface of equal contribution. As discussed extensively above, Leupold does not disclose a magnet in which the magnetization direction varies to control the magnetic field produced by the magnet at a selected point. The magnetization direction in the Leupold magnet varies to provide uniformity throughout a volume. This is a different problem, with a very different solution in terms of magnetization directions. Leupold does not disclose such a magnet, nor does Leupold suggest making a magnet optimized for a "selected point" rather than a volume. However, claim 49 further requires that the back face of the magnet substantially conforms "to a surface of equal contribution". Leupold shows simple geometric shapes. Leupold does not teach shaping a part of a magnet according to a surface of equal contribution, nor does Leupold even disclose what those surfaces are.

The Invention Set Forth in Claims 9-10 Would Not have Been Obvious Under 35 U.S.C. § 103 from Leupold in view of Golden et al.

Claim 9

Claim 9 requires "using the magnet of claim 1 to project magnetic field into a patient to control a magnetic medical element inside the patient." The magnet of claim 1 is not anticipated by, or obvious from, either Leupold or Golden et al., and thus using such a magnet could not have been obvious from Leupold. Moreover, Leupold only discloses magnets in which the useful magnetic field in an inside volume, and thus it could not be obvious to such a magnet to apply a magnetic field to a subject's body – the body would have to be positioned in side the magnet.

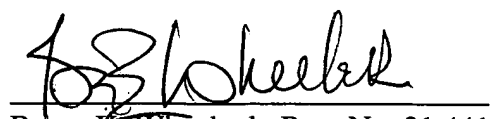
Claim 10

Similarly, claim 10 requires "using the magnet of claim 5 to project a magnetic field into a patient to control a magnetic medical element inside the patient." The magnet of claim 1 is not anticipated by, or obvious from, either Leupold or Golden et al., and thus using such a magnet could not have been obvious from Leupold. Moreover, Leupold only discloses magnets in which the useful magnetic field in an inside volume, and thus it could not be obvious to such a magnet to apply a magnetic field to a subject's body – the body would have to be positioned in side the magnet.

Conclusion

Leupold does not teach a magnet in which the magnetization direction varies to optimize a magnetic field property at a selected point. At most, Leupold teaches a magnet in which the magnetization direction varies to provide a uniform field over a volume. Moreover, in the claimed invention the magnetization direction of the various segments is the direction that at the center of mass that optimizes the particular property (claims 36 and 44), or which at the center of magnetic action optimizes the particular property (claims 37 and 45). In contract in Leupold the direction depends on the average polar angle of the segment. Finally, in the claimed invention, at least a portion of the surface is bounded by surface of equal contribution to the selected field property at the selected point (claims 34-40, 42,49-51), while in contrast Leupold teaches basic geometric shapes such as cylinders and spheres, independent of the surface of equal contribution, and does not even disclose what the surface of equal contribution is. For at least these reasons, the claimed invention would not have been obvious from Leupold or Golden, and thus the rejection of claims 1-2, 5-6, 9-10, 31-51 should be reversed.

Respectfully submitted,



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CLAIMS ON APPEAL

1. A permanent magnet in which the magnetization direction varies in three dimensions with location to optimize a desired magnetic field property in a selected direction at a selected point.

2. The permanent magnet in accordance with claim 1 wherein the desired magnetic field property is selected from transverse magnetic field, axial magnetic field, axial gradient of the transverse magnetic field, transverse gradient of the transverse magnetic field, axis gradient of the axial magnetic field, transverse gradient of the axial magnetic field, the product of the transverse magnetic field and the transverse gradient of the transverse magnetic field, the product of the transverse magnetic field and the axial gradient of the transverse magnetic field, the product of the axial magnetic field and the transverse gradient of the axial magnetic field, or the product of the axial magnetic field and the axial gradient of the axial magnetic field.

5. A permanent magnet in which the magnetization direction varies in two dimensions with location to optimize a desired magnetic field property in a selected direction at a selected point.

6. The permanent magnet in accordance with claim 5 wherein the desired magnetic field property is selected from transverse magnetic field, axial magnetic field, axial gradient of the transverse magnetic field, transverse gradient of the transverse magnetic field, axis gradient of the axial magnetic field, transverse gradient of the axial magnetic field, the product of the transverse magnetic field and the transverse gradient of the transverse magnetic field, the product of the transverse magnetic field and the axial gradient of the transverse magnetic field, the product of the axial magnetic field and the transverse gradient of the axial magnetic field, or the product of the axial magnetic field and the axial gradient of the axial magnetic field.

9. A method of performing a medical procedure using the magnet of claim 1 to project magnetic field into a patient to control a magnetic medical element inside the patient.

10. A method of performing a medical procedure using the magnet of claim 5 to project a magnetic field into a patient to control a magnetic medical element inside the patient.

31. A permanent magnet in which the magnetization direction varies with location to optimize the magnetic field at a selected point in a selected direction, the magnetization direction varying in three dimensions so that the magnetization at each location in the magnet is in the direction that substantially optimizes the desired magnetic field property at a selected point in the selected direction.

32. A permanent magnet in which the magnetization direction varies with location to optimize the magnetic field at a selected point in a selected direction, the magnetization direction varying in two dimensions so that the magnetization at each location in the magnet is in the direction that substantially optimizes the desired magnetic field property at a selected point in the selected direction.

33. A permanent magnet in which the magnetization direction varies with location to optimize the magnetic field at a selected point in a selected direction, the magnet comprising a plurality of permanent magnet segments, the magnetization direction of each permanent magnet segment varying in three dimensions so that the magnetization direction of each permanent magnet segment is in the direction that substantially optimizes the magnetic field at the selected point in the selected direction.

34. The permanent magnet according to claim 34 33 wherein at least a portion of the surface of the magnet conforms to a surface of constant contribution to the desired magnetic field at the selected location point.

35. The permanent magnet according to claim 34 wherein the direction of magnetization throughout each permanent magnet segment is constant.

36. The permanent magnet according to claim 35 wherein the direction of magnetization throughout each permanent magnet segment is the direction which, at the center of mass of the segment, provides the maximum contribution to the desired property optimizing the field.

37. The permanent magnet according to claim 35 wherein the direction of magnetization throughout each permanent magnet segment is the direction which, at the effective magnet center, provides the maximum contribution to the desired property optimizing the field.

38. The permanent magnet according to claim 35 wherein the size and position of the permanent magnet segments is selected so that the difference in the direction of magnetization direction between adjacent magnet segments is less than about 45°.

39. The permanent magnet according to claim 38 wherein the size and position of the permanent magnet segments is selected so that the difference in the direction of magnetization direction between adjacent magnet segments is less than about 30°.

40. The permanent magnet according to claim 35 34 wherein the magnetization direction throughout each permanent magnet segment is not constant.

41. A permanent magnet in which the magnetization direction varies with location to optimize a the magnetic field at a selected point in a selected direction, the magnet comprising: a plurality of permanent magnet segments, the magnetization direction of each permanent magnet segment varying in two dimensions so that the magnetization direction of each permanent magnet segment is in the direction that substantially optimizes the magnetic field at the selected point in the selected direction.

42. The permanent magnet according to claim 41 wherein at least a portion of the surface of the magnet conforms to a surface of constant contribution to the desired magnetic field at the selected location point.

43. The permanent magnet according to claim 41 wherein the direction of magnetization throughout each permanent magnet segment is constant.

44. The permanent magnet according to claim 43 wherein the direction of magnetization throughout each permanent magnet segment is the direction which, at the center of mass of the segment, provides the maximum contribution to the desired property optimizing the field.

45. The permanent magnet according to claim 43 wherein the direction of magnetization throughout each permanent magnet segment is the direction which, at the effective magnet center, provides the maximum contribution to the desired property optimizing the field.

46. The permanent magnet according to claim 43 wherein the size and position of the permanent magnet segments is selected so that the difference in the direction of magnetization direction between adjacent magnet segments is less than about 45°.

47. The permanent magnet according to claim 46 wherein the size and position of the permanent magnet segments is selected so that the difference in the direction of magnetization direction between adjacent magnet segments is less than about 30°.

48. The permanent magnet according to claim 43 41 wherein the magnetization direction throughout each permanent magnet segment is not constant.

49. A permanent magnet in which the magnetization direction varies to control the magnetic field produced by the magnet at a selected point, the magnet having a front face, and a back face substantially conforming to a surface of equal contribution.

50. The permanent magnet according to claim 49 wherein the magnetic material is monolithic with a continuously variable varying magnetization direction.

51. The permanent magnet according to claim 49 wherein the magnetic material comprises a plurality of discrete magnet segments, with the magnetization direction of each segment having a constant magnetization direction.

CERTIFICATE OF MAILING

I certify that on February 20, 2004, APPLICANTS' BRIEF ON APPEAL (in triplicate) was sent by first mail to the U.S. Patent and Trademark Office, address to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

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